U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 144.

Experiment Station Work,

XIX.

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FEEDING RICE MEAL TO PIGS.
DRESSING AND PACKING POULTRY
THE CURING OF CHEESE.
AN IMPROVED COW STALL.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

CONTENTS OF THE SERIES OF FARMERS' BULLETINS ON EXPERIMENT STATION WORK.

EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK—XIX.[1]

MAINTENANCE OF SOIL FERTILITY.

E. F. Ladd, of the North Dakota Station, reports experiments and observations which lead to the conclusion "that humus, at least in regions of low annual rainfall, like the Dakotas, plays a more important rôle in agriculture than has generally been ascribed to it." It may safely be said that this is generally true. Professor Ladd's investigations show that as humus decreases in soils they "become less productive, less retentive of moisture, and inferior in physical quality, while on the other hand it was found that an increase in the percentage of humus is accompanied not only with an increase in percentage of phosphoric acid extracted with the humus, but also with a greater productivity of the soil. * * * As the humus increases it seems to cause portions of the phosphoric acid, till then existing in an insoluble form, to become transformed into a soluble form, and thus, presumably, to become more readily available as plant food. The same is true as regards the potash, lime, and other soil constituents."[2] If more attention were given to maintaining an abundant supply of humus (partially decayed organic matter) in soils, they would be more productive, require less artificial fertilizing, and respond more generously when commercial fertilizers are used. To keep the soil in the best chemical and physical condition Professor Ladd maintains that a system of rotation should be practiced, which alternates humus-producing with humus-consuming crops. Two of the former to three of the latter should, with proper cultivation, maintain the soil in the highest state of productiveness. In fact, Professor Ladd claims

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[1] This is the nineteenth number of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

[2] See also U. S. Dept. Agr., Farmers' Bul. 78 (Experiment Station Work, V), p. 5.

that "soils fertile by nature, such as the Red River Valley soil, should, under a system of agriculture, as indicated above, yield good crops without the aid of commercial fertilizers for a thousand years. This assumes the proper use of all barn manures and the prevention of unnecessary loss from the soil. A proper system of crop rotation should result in enriching the surface soil with plant food rather than in depleting it, and especially should this be true for nitrogen and humus." On the other hand the continuous growing of wheat or other grains or cultivated crops rapidly diminishes the supply of organic matter and hence decreases the humus and nitrogen. The growing of leguminous plants—clover, peas, etc.—which are nitrogen accumulators, in a crop rotation causes a marked increase of humus and nitrogen in the soil. In the North Dakota experiments the plowing under of green crops did not produce as beneficial results as came from the breaking of grass lands. "Plowing under a green crop leaves the organic matter in a mass and not uniformly distributed throughout the soil. * * * Soils filled with a mass of grass roots furnish, in all parts of the soil, a uniform supply of organic matter, which by gradual decay furnishes the soil humus. This humus, reacting upon the mineral constituents of the soil, seems to aid in liberating and rendering available this plant food." Moreover, the newly broken soil being permeated by a mass of fine grass roots is thus protected from being drifted by the wind. The system of rotation recommended as most nearly ideal for the maintenance of the fertility of the soil is "two years in grass, followed by a cultivated crop, then two years in grain crops."

The continuous growing of wheat or other grain or of a cultivated crop not only rapidly depletes the soil of organic matter, but causes the rapid formation of nitrates, which are likely to be washed down in the soil below the reach of the roots of plants. In Professor Ladd's experiments the largest amount of nitrates was found at a depth of 3 feet in bare fallow, while at a depth of 7 feet the amount of nitrates was larger than at a depth of 1 foot. Since no nitrifying organisms were found in the soil at a greater depth than 2 feet, it is evident that the nitrates found at a greater depth than this were leached down from above. The importance of a proper rotation and of catch crops to take up and hold the nitrates is thus clearly shown. (See also article on rotation of crops, p. 8.)

THOMAS SLAG.

This material, also known as phosphatic slag, basic slag, odorless phosphate, and Thomas phosphate powder, is a by-product in the manufacture of steel from phosphatic ores by the basic or Thomas process, in which phosphorus is eliminated from the pig iron by means of a basic (rich in lime) lining to the Bessemer converters, and by adding lime to the molten pig iron. The slag is therefore rich in lime (about 15 per

cent in the free state and 40 per cent combined with other substances). The phosphoric-acid content of the product as found in the market is very variable, ranging from 10 to 25 per cent. Slag of average quality contains 15 to 20 per cent of phosphoric acid. In good slag 80 per cent of this phosphoric acid should be available, as shown by the chemical methods of determining availability, i. e., by treatment with a solution of citric acid or ammonium citrate. The phosphoric acid of slag, unlike that of superphosphates, is practically insoluble in water. Recently attempts have been made with some success to prepare a slag in which the phosphoric acid is more available, by fusing the product as obtained from the converters at about 900° C. with sufficient silica (quartz) to convert the free lime into silicate. Such slag differs materially from the untreated product not only in containing a higher percentage of available phosphoric acid and of silica, but in being practically devoid of free lime. Basic slag is not suited to the manufacture of superphosphates, and is therefore generally used without any treatment except fine grinding. Purchasers of Thomas slag should insist on its being very finely ground, as the value of the material depends very largely upon its fineness.

Slag has been used in large quantities in Europe for a number of years. In 1899 1,655,000 tons of slag are stated to have been used in Europe. Of this, 895,000 tons was used in Germany and 170,000 in France. In 1885 the use of this material was practically confined to Germany, and amounted to only 5,000 tons. The total consumption of phosphatic fertilizers in Germany in 1899 was 1,864,000 tons; in France, 245,000 tons—showing that nearly half of the phosphatic fertilizers used in these countries was Thomas slag. Slag has not been extensively introduced into the United States. The larger part of that used in this country is imported from abroad. Some has been manufactured at Pottstown, Pa., and put on the market under the name of "odorless phosphate," and it is expected that the slag will soon be made at Birmingham, Ala., and probably elsewhere in this country in the course of time. The use of slag, however, is increasing in this country, and it is important that farmers should be informed as to the composition and character of the material, so that they will not be misled by false or extravagant claims regarding it. Many of the stations have examined the product, and a number of them have experimented with it as a fertilizer. These experiments have shown it to be a very valuable phosphatic fertilizer, and, on account of its high percentage of lime, especially suited to use on acid soils and those rich in organic matter. It would not be wise to use it freely on poor, sandy soils deficient in organic matter. Dr. C. A. Goessmann, of the Massachusetts Station, says, in a recent report of that station: "Summing up the results of the past, it will be admitted that a genuine phosphatic slag, judiciously applied, has proved a valuable addition to our manurial resources, and that its use

is only limited by its supply at a reasonable cost." In the same report Prof. W. P. Brooks gives an account of experiments extending through several years which show that slag and dissolved boneblack are about equally effective, taking into account the after effects of the slag, while the cost of the latter is nearly twice that of the former. In experiments at the Maryland Station "slag phosphate produced a greater total yield and at less cost than the average of the soluble phosphoric-acid plats."

Slag appears to be especially suited to leguminous crops. Six hundred to 1,000 pounds per acre is considered a liberal dressing. It should not be mixed with ammonium sulphate before use, since its high percentage of free lime is likely to cause a loss of ammonia by volatilization. Mixtures of the slag with other salts, such as muriate of potash and nitrate of soda, cake badly and are difficult to handle and distribute uniformly.

ROTATION OF CROPS.

The benefits of rotation in crop production have been long recognized and various systems have been practiced. The reasons for such benefits and the best systems to be followed have been studied only in recent years. Many of the experiment stations are carrying on work along this line. As it takes some time to gain definite results, the greater amount of it has not as yet been reported. The objects to be attained in a system of rotation are the maintenance of fertility with the continued production of crops and the increase in productiveness of naturally poor or worn-out soils.

The results of rotations carried on at the Rhode Island Station are now being reported in a series of bulletins. These experiments were made for the purpose of improving worn-out soils. The soil used was very poor and had become so reduced by continuous cropping as to be wholly unfit for producing profitable crops. During one season planted to corn the plants made a growth of only 5 or 6 inches. The method adopted to bring this soil up to a state of fertility was to combine rotation of crops with application of commercial fertilizers. An account was kept of each plat, charges being made for fertilizer and labor and credit being given for crops produced.

The reasons for rotating crops are stated to be as follows: All plants do not draw to an equal extent upon the manurial ingredients of the soil. They send their roots to different depths and have a different solvent action upon the constituents they reach. By rotating crops insect enemies are more apt to be dispersed. Fungous diseases may also be materially reduced. The soil is maintained in good tilth, and bacteria which are beneficial to the plants are more likely to be increased. Weeds are more readily eliminated, the humus compounds of the soil increased, and the work of the farm more easily distributed.

The rotations reported are of 3, 4, and 5 year periods. During the

first course, in a 3-year rotation of potatoes, winter rye, and clover, the value of the crops was less than the total expenses in 5 out of 9 instances, the average loss per year amounting to $6.79 per acre. During the second course of the rotation there was an average profit of $23.54 per acre annually. In the 4-year rotation of corn, potatoes, winter rye, and red clover the expenses of the plats in the first period of the rotation were greater than the income from the crop produced. During the second course, as far as reported, good profits resulted. In undertaking the renovation of poor land by such means as those described some ready capital is necessary until the land can be brought to a paying basis. In a 5-year rotation of corn, potatoes, winter rye, and grass two years the results were not as favorable as in the two cases previously mentioned.

A series of rotations has been carried on for fifteen years at the Missouri and Indiana stations. At the Missouri Station relatively large yields were obtained by this method over continuous cropping. At the Indiana Station the conclusion has been reached that not only can larger crops be secured, but that the fertility of the soil can be better improved by judicious rotations. A comparison of continuous grain growing with the rotation of grain with grass and clover showed a gain by the latter method of 6 bushels of corn, 7 bushels of oats, and 6 bushels of wheat per acre. The average percentages of gain were for corn 22 per cent, oats 26 per cent, and wheat 44 per cent.

In such systems of farming as sugar production in the South and wheat production in the Northwest, a condition has been reached, even upon land originally of great fertility, where a system of rotation must be employed. In Louisiana the growing of a leguminous crop, like the cowpea, has become a necessity with the sugar planter. The North Dakota Station has taken up the study of a suitable rotation for the wheat farm. Experiments carried on for six years show that continuous wheat culture is unprofitable, while wheat in rotation increases in yield and improves in quality. Three crops of wheat and one of clover gave in four years almost as much wheat and more profitable returns than four crops of wheat in succession. Little was gained in rotating wheat with other cereals, as spring rye, barley, and oats, but wheat after a cultivated crop gave a larger percentage of increase than wheat after summer fallowing, millet, timothy and clover, flax, field peas, or peas and millet. The increase in the wheat crop over wheat after wheat was as follows: After cultivated crops, 75 per cent; after fallow, 63 per cent; after millet, 41 per cent; and after timothy and clover, 33 per cent. When a cultivated crop will only pay for the labor of its production it is better than summer fallowing, as the succeeding wheat crop will show.

The Ohio Station has made a study of the application of fertilizers in rotative croppings. Their experiments indicate that with crops grown continuously the cost of the fertilizer has been greater than

the value of the crop produced. Where grains have been grown in rotation with clover, the cost of the fertilizer has been recovered, with a margin to spare. In growing cereals continuously the recovery of the fertilizing ingredients applied is never in excess of 60 per cent. Nitrogen appears to be the element first exhausted in continuous grain culture. Grains grown in rotation with clover recover the nitrogen applied and a part of that stored up by the clover. The conclusion is reached that at the present prices for grains and fertilizers the use of commercial fertilizers, and even of barnyard manure, if valued on the same basis, is not profitable on wheat, oats, and corn, except when those crops are grown in a systematic rotation with clover or some other nitrogen-collecting crop. The poorer the soil the smaller the probability of profitable crops by the use of artificial fertilizers.

The Minnesota Station has studied the effects of the rotation of crops upon the humus content, as well as upon the fertility of the soil. Wheat grown continuously for four years removed annually 25 pounds of nitrogen per acre, while 146 pounds more were lost. "This nitrogen was lost by the oxidation of the humus, by denitrification chemically, by wind storms, and through the loss of nitrates by drainage." As a crop of spring wheat occupies the ground during a short portion of the year, it may be seen that during the greater part of the year the other factors are at work in eliminating this element. In a rotation of wheat, clover, wheat, and oats, an average of 178 pounds of nitrogen per acre was removed annually, yet there was a gain for four years over and above this amount of 245 pounds of nitrogen. "This nitrogen, it is believed, has been gained largely by the clover from the free nitrogen of the air." In this rotatiou not only was the nitrogen and humus content of the soil increased, but larger crops were grown.

With corn grown continuously for four years, the soil lost annually 85 pounds of nitrogen. Of this amount only 56 pounds were removed by the crop. The anuual loss with an oat crop grown contiuuously was 150 pounds of nitrogen, while only about 46 pounds were removed by the crop. Barley removed about 30 pounds of nitrogen per acre, and there was lost an additional 190 pounds. With continuous wheat culture there was an annual loss of 1,800 pounds of humus per acre, and with the continuous culture of corn, oats, and barley an annual loss of 1,500 pounds. The plats under continuous culture became lighter in color and heavier than those where rotation was practiced. The fallowing of the land resulted in a great loss of nitrogen, as five times as much was rendered available as the crop following could utilize, and the excess was lost by leaching. The gain with clover in a rotation was 5 bushels of wheat and 17 bushels of corn per acre.

Any scheme of rotation should have the growing of at least one leguminous crop in its plan. By this means large gains of nitrogen may be made from the air. Potash and phosphoric acid, unless

already in the soil, must be supplied by commercial fertilizers. In the case of very poor soil it is not advisable to remove the crops, unless the manure is returned, until a fair state of fertility has been reached. Stock raising, dairying, and poultry raising are profitable lines of agriculture to carry on in a scheme for improving the fertility of poor soils. A rotation for dairy farms recommended by the New Jersey Station consists of (1) field corn, seeded to crimson clover in July or August; (2) crimson clover followed by fodder corn, land seeded to winter rye; (3) rye fodder, followed by oats and peas, seeded to red clover and timothy, and (4) hay. A three-year rotation for the South recommended by the Louisiana Station is (1) corn; (2) oats, followed by cowpeas; and (3) cotton.

At the Delaware Station a good rotation for a poor soil in bad condition was (1) sweet corn, crimson clover; (2) cowpeas, winter oats; and (3) red clover. A fertilizer was also applied. The results reported indicate that it is better to have crops growing continuously upon the land than to have it lying idle during a part of the growing season.

A scheme of rotation suited to any individual case can not be laid down. It will depend upon the soil, climate, market, and to some extent on the season. While definite schemes have been employed by the stations in studying the question of rotation, the farmer will find that owing to conditions that arise he must vary his plan from time to time. He must, however, keep in mind the ultimate end of his efforts, which should be to maintain or improve the fertility of his soil.

GARDENING UNDER GLASS.

Under the above caption the point is made by W. F. Massey, of the North Carolina Station, that market gardeners in the South Atlantic coast plain do not sufficiently intensify their operations. The area cultivated is generally too large for the most satisfactory results. Not enough glass is used. North Carolina is as near New York City as Vermont is, and much better adapted to growing crops under glass because of the simpler structures needed, the less coal required for heating them, the absence of long-continued cloudy weather, and the greater abundance of winter sunshine. Yet Vermont competes with North Carolina in the New York market. Crops like lettuce, which grow in the North in the hothouses, can be grown in the South in simple frames under loose glass sashes in the greatest perfection, an advantage which Southern planters should not be slow to avail themselves of.

The common practice of growing lettuce in the South under cloth, for market, is discouraged. Glass should be used instead. It is more efficient and much cheaper in the long run. With glass other crops besides lettuce, like beets and radishes, can be grown in the winter, and seedlings of eggplants and tomatoes forwarded in the spring. After skill has been attained in handling sashes on a cold

frame, the transition to the greenhouse and heated hothouse follows naturally. Crops which require little skill in their production in the open ground can be grown by anybody and are cheap. The greater skill which is necessary in growing crops under glass limits competition and increases the profits.

The lettuce, for instance, which is grown under plant cloth, goes to market usually in barrels, and is sold as "Southern field lettuce" by the barrel. Lettuce grown well under glass and shipped in handy boxes is sold by the dozen at a higher price, and competes with the Northern greenhouse lettuce. The gardener with glass gets his lettuce into market at the Christmas holidays, and is ready at once to replant for a crop to compete on more favorable terms with the crop of the man who is using cloth, and as the spring crop usually sells for more than the midwinter crop, his lettuce, being in better condition, brings more money. I have gotten three times the price for lettuce the 1st of April that I got during the winter months, though the first paid very well. The many uses to which glass sashes can be applied is another argument for their use. After the lettuce crop is shipped the tomato plants are hardened off in the frames, and as after the 1st of March in this climate the lettuce does not need the glass, an extra set of frames can at once be used for the tomato plants that have been started in hotbed or greenhouse. And after the tomato plants are removed to the field the very tender eggplant can be set in the frames and protected during the chilly nights, and thus brought on at a time when it will command a good price. Or a hill of cucumbers can be planted under each sash from plants started in pots in the greenhouse and brought on earlier than those in the open ground far south of us. Then after all the plants have used the glass there is no better place for the drying of fruit in summer than under these same sashes. Those whose interest is in the strawberry crop can use the sashes to cover strawberry plants set for this purpose in frames, and if the sashes are put over them the 1st of March or a little earlier the crop is rapidly advanced and the blooms protected from frost, so that the fruit goes to market far ahead of the open-air crop.

As the use of sashes is more economical and better than plant cloth, so "a small fire-heated greenhouse is far better, and in the long run cheaper, than the manure-heated hotbed." The novice, however, will need to go slow in its use until he learns by experience. Meanwhile sashes should be substituted for plant cloth, and the quality of the product produced thus improved.

WINTER IRRIGATION OF DECIDUOUS ORCHARDS.

Fruits can be successfully grown in the valleys of southern Arizona only by the aid of irrigation. Until within recent years it has been the common practice of fruit growers in that section to irrigate orchards once or twice a month from February until October. The summer supply of water for this purpose is often inadequate, for, while the heaviest rainfall occurs during midsummer, the amount of water available for crops is only about one-third of that available in winter. In 1898 experiments were begun by A. J. McClatchie, of the Arizona Station, for the purpose of determining to what extent summer irrigation of the deciduous orchard fruit trees might be rendered unnecessary by the liberal application of water during winter, when the supply was comparatively abundant. A portion of an

orchard consisting of three rows of peach trees and two rows of apricot trees, set 24 feet apart, was selected for the experiment. The trees were 7 years old and the soil was a clayey loam. No water was applied to the trees from September until January 9, when the winter irrigation was begun and continued until March 31. In all, eight irrigations were made, the water being applied by the furrow system. As soon after the last irrigation as the condition of the soil permitted, the orchard was harrowed crosswise of the furrows to check evaporation. Subsequently the orchard was plowed deeply and harrowed again. During the two months following no rain fell. The orchard was cultivated twice, but received no irrigation water until June 24, after which no more water was applied during the season. The effect of this treatment on the orchard is stated as follows:

> The orchard remained in excellent condition throughout the season. The trees grew thriftily and maintained a vigorous appearance all summer. The young shoots on the peach trees were 3 to 5 feet long and those on the apricot trees 4 to 6 feet long. The trees were well loaded with fruit that was larger than, and of superior quality to, that borne the previous year, when the orchard was irrigated frequently during the summer. The results of the season's experiment were satisfactory in every way.

During the season of 1899–1900 the winter irrigation was begun December 16 and continued up to March 5, when about 3 feet of water had been applied. As in the preceding year, as soon as the soil was dry enough it was plowed each way about a foot deep and harrowed thoroughly. After each summer shower the orchard was again cultivated to break up the crust that formed and to maintain a surface dust mulch 6 to 8 inches deep. No irrigation water was applied for eight months, during which period the rainfall was but 2½ inches, divided among five rains. Again the results were most satisfactory.

> As during the previous season, the trees remained in excellent condition throughout the summer. During May and June occurred the driest hot period of which there is a record in the valley. At the end of it the orchard showed no signs of drought whatever, the peach trees having made a growth of about 4 feet and the apricot trees a growth of 3 to 6 feet. During the dry, hot period mentioned above the apricot trees matured a good crop of excellent fruit. Many of the peach trees remained unusually heavily loaded with fruit that matured during July and August, the quality being fully up to that of the previous year. Though the summer continued unusually dry, the trees maintained a vigorous appearance until November. Though having received no irrigating water for eight months, at the end of a season during which many orchards died no thriftier or more vigorous orchard existed in the valley.

The advantages of winter irrigation and the reasons for the good effects obtained in the orchards by its use are stated as follows:

> During the winter the lower temperatures and the higher relative humidity cause evaporation to be much slower than during the remainder of the year. In applying water, therefore, comparatively little escapes into the atmosphere. The supply of water being greatest at that time of the year makes it possible to apply large amounts at short intervals, thus avoiding the loss that occurs if small amounts are applied at greater intervals. Then, too, the trees are dormant and

roots ueed little air; hence, no iujury is done them by keeping the soil supermoistened or by letting the snrface bake to some extent. Couseqnently, cultivation after each irrigation is not uecessary, much time thus being saved.

Trees make use of aud consquently need water much earlier than is commonly supposed. An examination made February 20, 1900, revealed that at the depth of 10 to 16 feet, eveu, young roots 3 to 6 inches long had already grown. At this date there were few above-gronnd indications of growth, and it would not have been supposed by making a casnal observatiou that the trees wonld make use of any water that might be applied. While the air above gronnd is still too cool to start the development of the bnds the roots far beneath the snrface are making a growth that prepares the tree for the demand for water that the leaves will make later. Thns, if the trees have an abundance of water during the winter, the early root growth that will be made will enable them to make a rapid growth as soon as the air above ground is warm enough to permit it. These facts acconnt for the rapid and vigorons growth that the winter-irrigated orchard made in early spring, compared with those that had uot been thns irrigated.

The soil on which the orchard grew was examined down to a depth of 34 feet. Roots were found in abundance at a depth of 12 to 16 feet, and many were traced beyond 20 feet (fig. 1). It is stated that "this characteristic is what makes it possible to store in the soil much if not all the water needed during the summer." An examination of the moisture content of the soil showed that—

The total loss of water from the npper 25 feet during the spring, snmmer, and autnmn of 1899 was abont 20 inches, of which about 80 per cent was lost the first three months, abont 16 per cent the next three, and only about 4 per cent the last three mouths. Decidnons orchards use aud need the major part of the water snpply during spring and early snmmer, which need cau best be snpplied iu most of southern Arizoua by filling the snbsoil with water dnriug winter.

Another feature of this work was the determination of the moisture in the soil dissipated by weed growth. A portion of the orchard which had been left uncultivated became overgrown by weeds. The moisture content of the upper 5 feet of this soil was determined and compared with the moisture content of the upper 5 feet of soil in cultivated portions. The examination, made May 23, showed that as a whole "the upper 5 feet of soil in the cultivated area contained over a third more water than the upper 5 feet in the uncultivated area," or about "twice as much available moisture." Some of the conclusions of the author are as follows:

The amonnt of water needed by a deciduons orchard to keep it in good condition in sonthern Arizona from March to November is abont 21 inches, which can be stored iu the soil by the application of abont 3 feet during winter. The amount that need be applied to grow a green-mannring crop and store enongh water in the soil to carry a decidnous orchard through the summer is abont 4 feet. Deep winter irrigation followed by thorough snmmer cultivation is better for deciduons orchards in sonthern Arizona than the freqnent application of small amounts of water dnring the growing season.

If abont the middle of the snmmer water is available in abundance, it would probably be wise to give the orchard a thorough irrigation in as short a time as possible, and then follow the irrigation with a thorongh plowiug, as in the spring after the winter irrigation ceases. Bnt frequent summer irrigations are decidedly not advisable under onr conditions, where the soil is fairly deep and retentive of moistnre.

While the lessons taught by these experiments apply specifically to Arizona conditions, as described at the beginning of this article, they

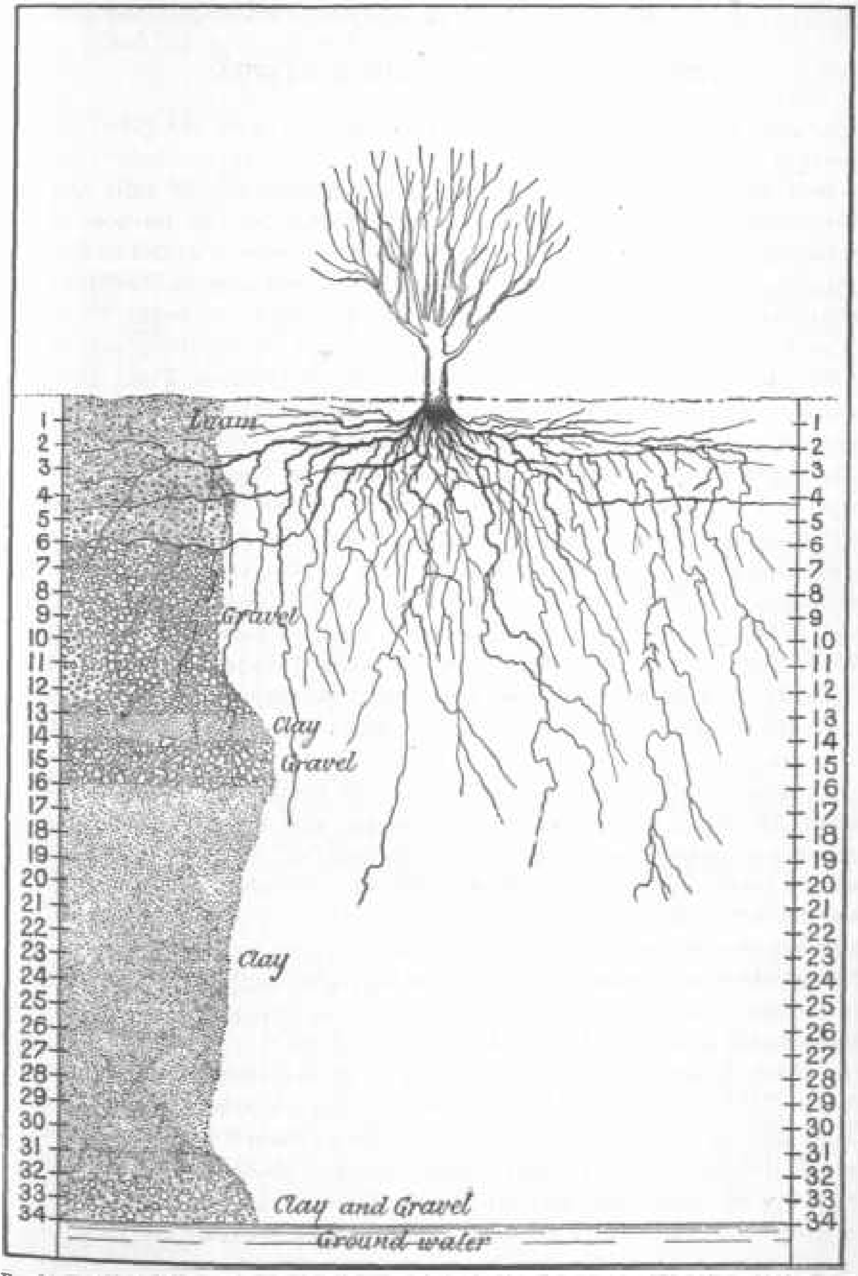


Fig. 1.—Soil strata in the winter irrigated orchard from the surface to ground water and the root system of one of the trees.

have a much wider application and value, for conditions similar to those of Arizona prevail extensively in other parts of the arid region,

where agriculture is dependent upon irrigation. Moreover, they emphasize the importance, even for humid regions, of keeping the soil in such condition that it will store up in time of abundant rainfall a sufficient supply of water to carry crops safely over a period of drought.

IMPROVEMENT OF AMERICAN GRAPES.

For more than twenty years T. V. Munson, of Texas, has given his attention to the subject of improving our native grapes—collecting the best wild and cultivated varieties, testing them side by side, and intermingling them by crossing and hybridizing for the purpose of producing new varieties of the best possible qualities, adapted to different parts of the country, and to provide the best possible resistant stocks upon which to graft the Vinifera (wine grape) varieties.

The methods of work, material employed, and the results obtained by Mr. Munson at his experimental grounds at Denison, Tex., have recently been reported by himself in a bulletin of the Texas Experiment Station, and this article is based upon that report.

His work has necessitated a careful study of the botany of the grape and a thorough knowledge of every native, introduced, and cultivated species and variety. In his work with these, more than 75,000 seedlings, mostly hybrids, have been grown, and of this number scarcely 100 have been considered worthy of introduction for market. When, however, it is remembered that no variety with fewer berries than Lukfata nor smaller berries than Talaquah nor inferior in quality to Concord has been considered worthy of introduction, some idea will be obtained of the rigid system of culling and selection observed.

Mr. Munson considers the results obtained in his experiments with native American species most encouraging, and the field of future development along this line practically unlimited. Our native species excel in many points the Old World grapes. "Some have rare, delicious flavors, unknown in the Vinifera varieties; others, great size of clusters; others, very large berries; others, small and few seed; all of great vigor and resistance to disease and adaptability to our variable climate. And our experience clearly shows that all species can be intermingled at will by the intelligent hybridizer."

In order to obtain an idea of the value of the varieties of grapes produced by Mr. Munson, some explanations are necessary regarding the conditions under which the varieties were grown. On the experimental grounds used, the phylloxera, mildew, black rot, brown rot, bird's-eye rot, bitter rot, and other rots, diseases, and insects affecting grapes are plentifully present. The climate is exceedingly variable and subject to sudden and severe changes, the temperature sometimes reaching 110° F. in the shade in the summer, and dropping to —15° F. in the winter, with an occasional fall in temperature of from 40° to 60° F. in twenty-four hours. The annual rainfall varies from

20 inches in some years to 100 inches in others and averages about 40. Nevertheless, varieties have been found and produced which resist all these unfavorable conditions and annually bear heavy crops. With this knowledge of the conditions under which Mr. Munson has worked, the following table, showing his botanical classification and his estimate of the cultural properties of the grape species as grown by him, will be of special value to grape growers in all parts of the country.

Cultural properties of grape species.

Specific and common name.	Growth, 1-5 (5 strongest).	Soil preferred.		Cutting root, 0-5 (5 easiest).	Endurance.		Resistance.			Size.		Persistence to pedicel, 0-5 (5 most).	Quality of fruit, 0-5 (5 best).	Season of leafing, flowering, and ripening.
		Sandy, 1-5 (5 most).	Limy, 1-5 (5 most).		Of heat and drought, 0-5 (5 most).	Of cold, 0-5 (5 most).	To phylloxera, 0-5 (5 most).	To mildew, 0-5 (5 most).	To black rot, 0-5 (5 most).	Of cluster, 1-5 (5 largest).	Of berry, 1-5 (5 largest).			
SECTION A—EUVITIS (TRUE GRAPES).														
GROUP I—MICROCARPÆ, OR SMALL-BERRY GRAPES.														
Series 1—Ripariæ.														
Vitis rupestris, Rock grape.	1-2	1	1-4	5	1-3	3-4	5	5	5	1-2	2	3-4	2-4	Very early.
V. longii (solonis), Bush or Gulch grape.	2-3	2	3	5	2-3	3-4	4-5	4-5	5	1-2	2	4-5	2-4	Early and very early.
V. vulpina (riparia), Riverside grape.	2-4	3-5	1	5	1-2	5	4-5	4-5	4-5	1-3	1-2	3-4	2-4	Do.
Series 2—Occidentales.														
V. treleasei, Smooth Canyon grape.	1-2	1-2	1-2	4	3-5	2-4	3-4	1-2	1-2	1-2	2	3-5	2-4	Medium.
V. arizonica, Downy Canyon grape.	2-4	1-2	1-3	3-4	4-5	2-3	3-4	1-2	0-1	1-2	1	4-5	4-5	Medium and late.
V. girdiana, South California grape.	3-5	1-2	2-3	2-3	4-5	1-2	2-3	0-1	0	2-4	2	4-5	3-4	Do.
V. californica, North California grape.	3-4	1-2	2-3	1-2	3-4	1-3	1-3	0	0	2-3	2	4-5	3-5	Do.
Series 3—Cordifoliæ.														
V. monticola, Sweet Mountain grape.	1-2	1-4	5	1-3	5	2-4	5	3-5	4-5	1-3	2-3	5	1-3	Medium and late.
V. rubra (palmata), Catbird grape.	2-3	1-3	3-4	1-2	2-3	4	5	5	5	2-4	1-2	5	2-4	Very late.
V. cordifolia, Frost, or Sour Winter grape.	4-5	1-3	3-4	1-2	3-4	2-4	5	5	4-5	2-4	1-2	5	1-2	Late.
Series 4—Cinerascentes.														
V. baileyana, Possum grape.	2-3	1-3	1-3	1-2	1-3	2-4	4-5	4-5	4-5	2-3	1	5	3-4	Late.
V. berlandieri, Little Mountain grape.	3-4	1-4	4-5	1-2	5	2-4	5	4-5	5	2-5	1-2	5	3-5	Late and very late.
V. cinerea, Sweet Winter, or Ashy grape.	4-5	1-4	3-4	1-2	4-5	2-4	5	4-5	5	3-5	1	5	2-4	Very late.
GROUP II—MACROCARPÆ, OR LARGE-BERRY GRAPES.														
Series 1—Viniferæ.														
V. bourquiniana, Southern Æstivalis.	3-5	1-4	2-3	1-3	4-5	2-3	3	1-3	1-4	2-5	2-3	5	4-5	Late.
V. vinifera, Asiatic Wine grape.	1-5	1-4	2-4	3-4	3-5	1-2	0-1	0-2	0-2	2-6	2-6	5	4-5	Early, medium, and late.

Cultural properties of grape species—Continued.

Specific and common name.	Growth, 1-5 (5 strongest).	Soil preferred.		Cutting root, 0-5 (5 easiest).	Endurance.		Resistance.			Size.		Persistence to pedicel, 0-5 (5 most).	Quality of fruit, 0-5 (5 best).	Season of leafing, flowering, and ripening.
		Sandy, 1-5 (5 most).	Limy, 1-5 (5 most).		Of heat and drought, 0-5 (5 most).	Of cold, 0-5 (5 most).	To phylloxera, 0-5 (5 most).	To mildew, 0-5 (5 most).	To black rot, 0-5 (5 most).	Of cluster, 1-5 (5 largest).	Of berry, 1-5 (5 largest).			
SECTION A—EUVITIS (TRUE GRAPES)—Continued.														
GROUP II—MACROCARPÆ, OR LARGE-BERRY GRAPES—Continued.														
Series 2—Æstivales.														
V. lincecumii, Post-Oak, or Turkey grape.	3-5	1-5	1-3	0-2	4-5	2-4	4-5	2-4	1-5	2-4	2-4	0-4	0-4	Medium and late.
V. bicolor, Blne grape	3-4	1-5	1	0-2	2-4	4-5	4-5	3-4	5	2-3	2	1-5	0-1	Late.
V. æstivalis, Snmmer grape.	3-4	1-5	1	0-3	2-4	2-4	3-4	4-5	4-5	2-4	2-3	1-5	0-4	Do.
V. simpsoni, Simpson's grape.	3-5	1-5	1-2	0-1	5	1-3	4-5	4-5	4-5	3-4	2-3	3-4	0-4	Late and very late.
Series 3—Coriaceæ.														
V. coriacea, Leather Leaf grape.	3-5	1-5	2-3	0-1	5	1-2	4-5	5	4-5	2	2-4	5	0-1	Medinm and late.
V. candicans, Mustang grape.	4-5	1-5	4-5	0-1	5	2-3	5	5	5	1-2	3-5	5	0-2	Medinm aud early.
V. doaniana, Texas Panhaudle large grape.	3-5	1-5	3-4	3-5	4-5	3-4	5	3-5	4-5	2-3	2-4	5	1-3	Early and very early.
V. champini, Adobe Land grape.	3-5	1-5	4-5	4-5	5	2-4	5	2-5	5	1-2	2-4	5	2-3	Medium, early, and very early.
Series 4—Labruscæ.														
V. labrusca, Northern Fox grape.	2-3	1-5	1	3-5	1-2	3-4	2-3	5	3-5	1-3	3-5	0-3	0-3	Medium, early, and very early.
SECTION B—LENTICELLOSIS.														
GROUP I—CHIRI-SIMPLESES.														
Series 1—Muscadinia.														
V. rotundifolia, Sonthern Muscadine.	4-5	1-5	2-3	0	4-5	1-3	5	5	5	1	3-5	0	3-4	Very late.
V. munsoniana, Florida Bird grape.	3-5	1-5	2-3	0	5	1-2	5	5	5	1-2	2-3	1-2	3-4	Do.

In accordauce with the cultural facts presented in this table, *V. vulpina*, *V. rupestris*, and *V. longii*, named in order of preference, are recommended as excellent grape stocks on sandy soils for the northern parts of regions like California, France, and other temperate climates where Vinifera grapes succeed. For moderately limy soils, *V. rupestris* and *V. doaniana* are recommended; and for very limy soils, where the ground does not freeze over 18 inches deep, *V. champini*. For grape stocks for any soil in very hot, dry regions, such as southwest Texas and southern California, *V. champini*, *V. doaniana*, *V. berlandieri*, *V. candicans*, and *V. monticola* are recommended.

"The last three, being difficult to grow from cuttings, are better utilized in hybrid varieties with the first two and with *V. rupestris*. *V. monticola*, *V. berlandieri*, *V. candicans*, and *V. champini*, while doing finely in sandy soil, grow the best of any species in very limy soils, up to 60 per cent of carbonate of lime."

In breeding direct producers of fruit for market and table for the North, the best varieties of *V. labrusca*, *V. vulpina*, *V. lincecumii*, *V. bicolor*, *V. rupestris*, and *V. doaniana* are to be selected, using the hardiest and healthiest varieties of *V. vinifera* in attenuation of one-fourth to one-eighth or less, by using hybrids and hybrids of hybrids as parents. In the breeding of direct producers for the South, the range is very great. Any of the above may be used, with the addition of *V. champini*, *V. bourquiniana*, *V. berlandieri*, *V. monticola*, and *V. rotundifolia*, and for Gulf regions and Florida, *V. simpsoni* and *V. munsoniana*.

As to species for wine, "it is found that small-berry species generally possess properties for wine making far superior to the large-berry species; hence if one seeks to produce varieties for wine making he should not neglect those with small berries. The species possessing best wine properties are those in the series Ripariæ, Viniferæ, Æstivales, Cinerascentes, and Coriaceæ, especially the species *rupestris*, *bourquiniana*, *lincecumii*, *berlandieri*, *champini*, *doaniana*, and *vinifera*."

Reviewing these species selected for special purposes, it is found that American viticulture is based on the following species: *Rupestris*, *longii*, *vulpina*, *monticola*, *berlandieri*, *bourquiniana*, *vinifera*, *lincecumii*, *bicolor*, *æstivalis*, *simpsoni*, *candicans*, *doaniana*, *champini*, *labrusca*, *rotundifolia*, and *munsoniana*, seventeen in all. "These, with proper application as to climate and soil, can well supply all parts, from Puget Sound and Dakota to Porto Rico. All the other species can be neglected without loss. An abridgment of the above, which would still supply nearly every requirement and be the best possible list for the number of species included, would be *rupestris*, *vulpina*, *berlandieri*, *bourquiniana*, *vinifera*, *lincecumii*, *simpsoni*, *doaniana*, *champini*, *labrusca*, and *rotundifolia*."

In breeding for special characters and purposes, as for color, season of ripening, size of cluster, better quality, etc., varieties must be selected and paired which embody the greatest number of elements of the ideal variety sought. The law is that "like produces like." To produce white varieties surely, cross or hybridize white varieties. To overcome elements of weakness, use only the most vigorous vines as parents. Early ripening parents produce early ripening progeny; little would be gained in crossing a very early and a very late variety. Size of cluster and berry follow the general law that "where the berry is large the cluster is small, and where the cluster is large the berry is small." Early ripening species have both berry and cluster small,

and it would seem, therefore, that the large-clustered, large-berried varieties are the result of selection and breeding by man. "It is in this particular possibility of development where the hybridizer of American grapes may accomplish wonders. * * * Large-clustered foreign grapes may be excelled in American species some day."

In selecting parent varieties of grapes for special purposes there are certain general qualities, in addition to the particular characteristics which make them especially suitable for the purpose in view, which, in the opinion of Munson, every valuable variety must possess, and these general qualities combined make up the ideal vine. These general qualities are:

(1) Great vigor, hardiness, long life in the climate for which it is desired; (2) greatest possible resistance to phylloxera, downy mildew, black rot, and leaf folder; (3) easily grown from cuttings; (4) perfect flowers, so that the vine will bear well standing alone; (5) prolific bearing; (6) large, full, handsome clusters; (7) berries persistent to the pedicels, with thin, delicate, yet tough, noncracking skin, without astringency or bitterness; color bright; pulp meaty, yet tender, juicy, readily freeing the seeds, of pure, fine quality, rich in sugar and agreeably sprightly with acid, and having a pleasing characteristic flavor; seeds few and small; if for table or market, berry large; of good keeping quality.

Such ideally perfect varieties are never found wild, but the more of these qualities a vine possesses the better suited it is to serve as a parent.

The general laws of constitutional development in grapes with reference to parentage in pollination which have been worked out are stated as follows:

The most vigorous and enduring progeny are produced by vines, as mothers, other things being the same, which have recurved stamens and well-developed pistils, when pollinated by purely staminate vines, as, for example, when Moyer, Lindley, Brighton, etc., are pollinated by staminate seedlings of, say, Dracut, Perkins, Presley, etc.

Next in vigor are the progeny of mothers having reflexed stamens with large pistils, impregnated by hermaphrodite vines, e. g., Brighton or Lindley by Concord, Ives, Delaware, etc.

The third in vigor and endurance would be the progeny of hermaphrodite vines, such as Concord, Ives, Perkins, Catawba, and the majority of varieties in cultivation, impregnated by staminate vines. But in this case the majority of the progeny will be staminate vines.

Fourth in vigor would be the progeny of hermaphrodite vines pollinated by other hermaphrodite vines—for example, Concord pollinated by Delaware or Ives—and still weaker if pollinated by itself or its own progeny, such as Moore Early, Worden, Martha, etc., making in-and-in breeding. The progeny of such impregnations generally have hermaphrodite or self-pollinating flowers, the kind preferred by vineyardists who do not understand sex among vines, because they bear planted alone in vineyards. Most hybrids of Labrusca with Vinifera have been of this class.

More feeble still, when any progeny at all are produced, is that of vines with recurved stamens impregnated by varieties with recurved stamens, as in case Moyer could be impregnated by Brighton or Lindley.

In case a variety with recurved stamens should impregnate itself, if possible,

we wonld expect the feeblest progeny. Snch impregnations, however, are very rare, if at all. Pistillate varieties thns pollinated generally cast the pistils in a few days afterwards, but the pistils may first enlarge a little. Prof. S. A. Beach has designated such varieties "self-excitant" or "self-irritant," bnt sterile.

Relative to prepotency, or superior potency of one parent over another, the author states that the mother appears to transmit its degree of hardiness in resisting climatic extremes and disease better than the male parent.

Generally, the more distinct and nniform a species the more prepotent it is over less distinct and less uniform species. In conformity to this, the more complex a hybrid is, the less it shows, of itself, in combination with a pnre variety of a pure species. Also in conformity to this law, the more complex a hybrid is, the more variable among themselves are its pnre seedlings.

We may expect the male parent to more often control in appearance and qnality in frnit and the female in vine; yet if we designate it a general law there will be fonnd many exceptions.

The more important results secured along this line with some fifteen groups of grapes, including many families, may be partially summarized as follows: *V. rupestris* does not seem to be a good mother, but in France is considered superior to all other species as a pollenizer of Vinifera to give direct producers. *V. berlandieri* offers an excellent basis on which to build for large compound clusters and fine quality of berry. *V. lincecumii*, in the opinion of Munson, promises more for American grape culture than any other and possibly all other species combined. Among the families of this group, America is uncommonly healthy and vigorous, very prolific, and is a good table and wine grape and one of the best of mothers. A hybrid of *V. bicolor* and *V. vulpina* promises to give rise to a family of very hardy varieties peculiarly adapted to the extreme north. *V. labrusca* is noteworthy for the large number of pure varieties for northern regions to which it has given rise. *V. simpsoni* endures great heat and drought and resists fungus diseases well, especially black rot, and promises well as a base for Gulf State varieties for extremely late ripening. *V. champini* promises much in hybrid combinations. It is a good grape stock for dry, very limy, adobe, or sandy soils, either North or South.

Attention has also been given to the requirements of the market as to color of fruits.

Any considerable market demands all the time three colors of grapes to satisfy all cnstomers. These are, in the order of preference or extent of demand, (1) bright, lively red, snch as Delaware, Flame Tokay, etc.; (2) black or dark pnrple, with clear complexion, snch as Black Hambnrg, Black Prince, Violet Chasselas, etc.—Concord is too dnll, has too mnch white flonr-like bloom; (3) translncent, yellowish varieties, snch as Golden Chasselas, Calabrian, etc. Niagara, when thoronghly ripe in sunny weather, does pretty well. Varieties that are green when ripe do not sell well.

In order to supply the market with fruit of each of the three colors required throughout the grape season, which extends from the last of

June to October in the South, a succession of about nine varieties of each color is necessary. An attempt was made to meet this want in the production of new varieties. The character of the varieties produced and their adaptability for this purpose is shown in the following table:

Suggested succession of varieties of grapes for the South.

Time of maturing.	Translucent red, as good or better than Brighton.	Bright black, as good as Concord or better.	White or yellowish white, as good or better than Niagara.
July 1-10.	Headlight and Pressly.		
July 10-20.	Pontotoc, Onyx. Tuskahoma.	Manito. Washita, Blackwood.	Marvina. Bell.
July 20-31	Brilliant, Yomaga.	Lukfata.	Wapanuka.
Aug. 1-10.	Amethyst, Tonkawa.	Delmerlie, Modena.	Rommel, Hidalgo.
Aug. 11-20.	Waneta.	Beacon, R. W. Munson. LaReine, America, Bailey, Captain, Carman, Xinta.	Estella, Tamala. Wetumka. Hopeon. Albania.
Aug. 21-31.	Big Hope.	Hopkins, Universal. Muench, Wine King.	Gold Coin. Onderdonk.
Sept. 1-15.	Fern and Laussel.	Kiowa, Husmann. Profusion, LaSalle.	Dixie.
Sept. 15-30.	Marguerite.	Wanbeck.	
Oct.		San Jacinto. Winter Wine.	

A detailed account of methods of growing grapes in the South and of Southern vineyard management may be found in Farmers' Bulletin 118, of this Department.

CONDIMENTAL AND MEDICINAL CATTLE AND POULTRY FOODS.

A recent bulletin of the Connecticut State Station reports the results of chemical and microscopical examinations of a number of samples of condimental and medicinal cattle and poultry foods, collected in Connecticut, in connection with the inspection of feeding stuffs carried on under the law in that State.

Of the cattle feeds, three have 24 per cent and more of protein—as much as is found in the gluten feeds; four others have about the same quantity of protein as wheat bran, and one has less than corn meal of average quality. No one of them is a "concentrated feed" in the common acceptation of that word.

Five of the number have considerable quantities of salt, amounting in one case to more than 16 per cent, and four contain sulphur, an old-fashioned "spring medicine." The largest quantity of sulphur found was 3.9 per cent. Charcoal is an ingredient of five of the cattle foods.

The poultry foods are not very different from the cattle foods, either in composition or in the materials of which they are made.

[The list of materials out of which these condimental foods are prepared] comprises the common feeds, cotton-seed meal linseed meal, wheat feed, corn meal, and malt sprouts, and the old-time remedies—sulphur, salt, Epsom salts, charcoal, cayenne, gentian, ginger, turmeric, and fenugreek, to which are added mustard hulls and cocoa shells.

The poultry foods are made up of these same things (some of them containing considerable quantities of salt), and in addition, iron oxid, carbonate of lime (shells), and ground bone. * * *

In the condimental foods examined no injurious drugs have been found. They

are for the most part old-time simple remedies which most farmers buy very cheaply at the village grocery or drug store and keep in the house for use.

There are only two things which call for further notice.

The claims made for these feeds.—The special claims made for these feeds in advertisements and on the containing packages are very numerous and are of two rather distinct kinds: First, that they are appetizers, giving an agreeable odor and taste to the feed, thus inducing stock to eat more of it, and also making them digest it better than they otherwise would; secondly, that the foods have great medicinal value.

The claims made under this latter head are as extravagant as those made for patent medicines sold for human use, and are supported in some cases by testimonials about as valuable. For example:

One "cures hog cholera, makes pigs grow quickly, dairy cows produce more butter and milk, stops slinking of calves * * * and regulates horses."

This takes the place of another article made by the same firm and is "much more highly concentrated." This highly concentrated feed, which cures hog cholera, contains less protein than any other of the condimental foods and consists of corn meal, salt, charcoal, fenugreek, and a bitter drug, probably gentian.

Another, which "is the most effectual and economical remedy known for diseases of cattle," guaranteed to cure "scours" in calves, consists of corn meal, linseed meal, charcoal, and sulphur.

Still another "is composed of laxatives and tonics in abundance, aromatics in just proportion, diuretics, expectorants, and alteratives." This beneficial mixture is made of linseed meal, corn meal, ginger, fenugreek, a bitter drug, and sulphur.

Other brands of condimental food with less remarkable claims for medicinal value are advertised as food "auxiliaries," "appetizers," and flesh and milk producers.

It is interesting to note that the poultry feeds are very like the cattle feeds, both in chemical composition and in materials used, so that were the claims of the manufacturers all valid, a condimental feed which would cure gapes in chickens might be expected to increase the flow of milk of cows and also to cure hog cholera.

The mildly curative properties of the various drugs used in these feeds are well understood by most dairy farmers, as well as their limitations.

The claims that by the use of condiments and spices the digestibility of food can be increased, and in this way a saving of feed can be effected, have no basis in fact. No experiments have demonstrated or made even probable such an effect. Stock feeders will be very slow to believe that cotton-seed meal, linseed meal, wheat feeds, or corn products can be made more easily digestible or even more acceptable to healthy cattle by mixing with them Epsom salts, charcoal, ginger, or fenugreek.

The prices of condimental feeds.—The cheapest of those collected in this State cost about 12½ cents per pound, the most expensive 20 cents.

As foods, pure and simple, such prices are ridiculous and prohibitive. If in large lots they can be bought at half or a quarter of the rates for small packages, even such a discount would make them twice as costly as our most expensive standard feeds, and no one of them is as concentrated a feed as either cotton-seed meal, linseed meal, or gluten meal.

In buying medicines mixed at a drug store one pays very much more in proportion than he would for the ingredients singly, in bulk, and in much larger quantity. He pays for the convenience of having all of them accessible in one place in as small amount as he desires, mixed accurately according to his written directions, and put up to be conveniently carried.

There is, however, absolutely no sense in buying at a very high price a lot of drugs of rather mild medicinal properties, of unknown kinds, and in unknown

proportions, which claim to take the place of a part of the food and to cure almost every ill and defect that cattle and fowls are heir to.

Salt, charcoal, Epsom salts, sulphur, fenugreek, gentian, cayenne, and ginger—they can all be bought probably in any village in Connecticut; they are already in the stables of many dairy farmers and are used by them; their value is well known, and also their uselessness for the treatment of serious illnesses.

FEEDING RICE MEAL TO PIGS.

In milling rice a number of by-products are obtained, including polish, bran, and hulls. Some straw, dust, etc., is usually found mixed with the hulls. A mixture of rice polish, rice bran, and rice flour is obtained at some of the rice mills and is called rice meal. Although there is no uniform way of marketing this by-product it is used to a considerable extent as a feeding stuff.

The South Carolina Experiment Station recently reported a test on the comparative value of rice meal and corn meal for pigs. The rice meal used is described as the total by-product obtained in cleaning the rice grains for the market. It contained about the same amount of protein, fat, and carbohydrates as corn meal. The test was made with two lots of three pigs each, about 5 months old at the beginning of the trial. The grain was mixed with skim milk in the ratio of 1:4, and the pigs were given all they would eat of the mixture. For thirty-one days lot 1 was fed the corn-meal ration and lot 2 the rice-meal ration. Then for a second period of twenty-two days the rations were reversed. Considering the test as a whole the average daily gain per pig on rice meal and skim milk was 1.72 pounds; the cost of a pound of gain, 3.84 cents; and 2.48 pounds of meal and 9.91 pounds of milk were required per pound of gain. On corn meal and skim milk the average daily gain per pig was 1.66 pounds; the cost of a pound of gain, 4.63 cents; and the food required per pound of gain, 2.57 pounds of meal and 10.28 pounds of skim milk. As pointed out by the station, rice meal had a feeding value equal to or greater than corn meal. According to the experimenter it has been noticed by feeders that the use of rice meal for fattening hogs had a tendency to weaken the intestines of the hog, but the test affords no data on the subject, as neither lot of pigs was fed on rice meal for the whole time.

Some years ago the Massachusetts Station compared rice meal and corn meal as a feed for pigs in a test made with two lots of three pigs each, which covered four months. The pigs were about 1½ months old at the beginning of the trial. At first the amount of grain given was about 4 ounces per quart of skim milk. The quantity was increased as the pigs grew older. The average daily gain per head on rice meal was 1.41 pounds and on corn meal 1.42 pounds. The amounts of food eaten per pound of gain were also practically the same in both cases. From these tests the conclusion was drawn that the two feeding stuffs had practically the same value for pigs. The average results of the two trials show that the coeffi-

cients of digestibility were as follows: Dry matter, 74; protein, 62; fat, 91; and nitrogen-free extract, 92 per cent.

The average coefficients for corn meal are: Dry matter, 89.4; protein, 67.9; fat, 92.1, and nitrogen-free extract, 94.6 per cent. The rice meal is therefore apparently slightly less digestible than corn meal, but in most respects it appears to be so nearly equal to corn meal in feeding value that it is worthy of attention in those regions where it may be easily obtained.

The station also tested the digestibility of rice meal by sheep.

DRESSING AND PACKING POULTRY FOR SHIPMENT.

In the poultry industry, as in every other, attractive marketing is an import feature, and one too often overlooked. Many of the products marketed by the farmer do not realize high prices owing to a lack of proper packing, or because some special requirement of the consumer is not complied with. The Canadian experiment stations have devoted considerable attention to the poultry industry. Special efforts have been made to learn the requirements of the English market. In a recent report of the Canadian Commissioner of Agriculture and Dairying, the methods of dressing, packing, and shipping poultry for British markets are discussed. Some of the directions for shipping turkeys seem of general application. Among the principal points are the following:

Plucked turkeys are regarded as more salable than unplucked. Fast the birds for twenty-four hours, to empty the crop and intestines. The fermentation of food in the crops and intestines will wholly spoil the birds. Give a small quantity of water just before killing. Kill by wringing the neck, and not by knifing or sticking. One dealer says the easiest and best mode of killing is by the dislocation of the neck. This manner of killing is generally adopted by the English and continental poulterers. It is done as follows: Grasp the legs of the bird in the left hand and the head of the bird in the right hand, the back of the bird being upward and the crown of the head in the hollow of the hand. Hold the legs of the bird against the left hip and the head against the right thigh or knee. In this position strongly stretch the head, at the same time bending it suddenly backward, so as to dislocate the neck near its junction with the head. The bird is killed instantly, and plucking the feathers must be proceeded with at once. The method of killing turkeys in Norfolk is also recommended. It is as follows: The bird is hung up by the legs, the wings being crossed to prevent struggling. Next it is given a sharp blow on the back of the head with a stout piece of wood, which renders it insensible. The knife is then inserted into the roof of the mouth, so as to pierce the brain, cutting it along the entire length. The bird is left hanging by the legs for a few minutes to allow the blood to drain out. Pluck at once, while still warm. Feathers should be left on the neck for about

3 inches from the head; also a few feathers on the tail and tips of wings. Do not tear the skin in plucking, and do not under any circumstances dip the bird into water. Remove the intestines from the rear. Care must be taken not to break the gall bag. All the rest may be left inside. Twist the wings on the back of the bird (fig. 2). A string, which, however, should not encircle the body, may be used to keep them in place. As soon as the feathers are off, hang the bird up by the feet to cool. Do not lay it down or hang it by the head. The blood should drain toward the head and become coagulated there. One dealer says to lay the birds on their breasts on a setting board, pressing the rumps square, letting the heads hang down until the body is set, when the birds will always retain their plump shape. Cleanliness is necessary. The feet and legs of the birds should be clean also. The legs of the dressed birds are often tied up as shown in fig. 3. If the birds are to be displayed in a shop the head should be pushed up under the wing. The birds should be thoroughly cooled (not frozen), and they should be cold through and through before being packed in cases. Pack in any one case only birds of nearly the same weight, graded to within 2 pounds. In no case should any bird be lighter than the lightest weight or heavier than the heaviest weight marked on the package. Pack the cocks and hens in separate cases. Mark the cases at both ends plainly. Wrap every bird neatly in paper. The head of each bird should be wrapped with a quantity of thick paper, to absorb any blood. Spread a small quantity of wood pulp or dry, clean straw in the bottom of the case. Put paper on the bottom and top of the birds to keep them clean. A small quantity of wood pulp or dry, clean straw may be put on top, directly under the cover. Pack the birds with backs down, with heads at one side. Put from twelve to twenty-four birds in a case. Every case should be packed quite full and close to prevent damage during transit. Do not export any old, tough birds. Every bird should show a good, plump, white, broad breast.

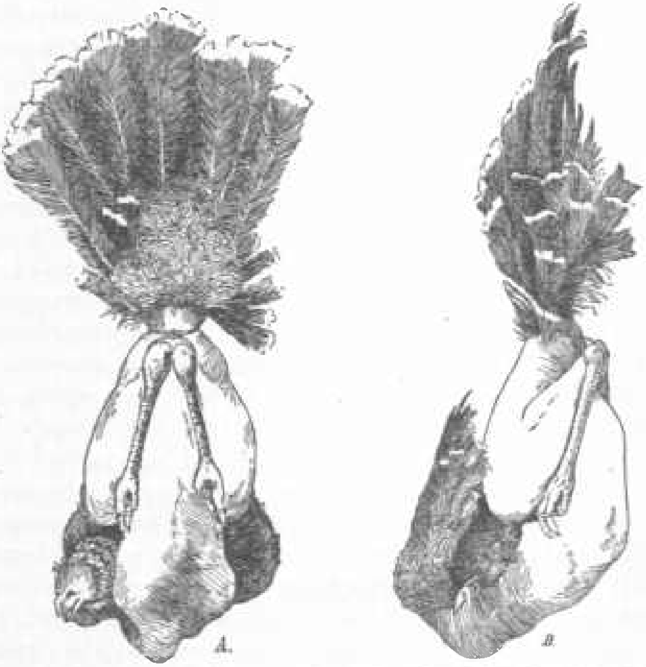
FIG. 2.—Method of twisting the wings of a turkey on the back.

Opinions differ in the United States regarding the practice of drawing poultry before marketing. While it is desirable to suit the demands of the market to which shipment is made, the following conclusions from recent American experiments are of interest:

Under precisely the same conditions of temperature and humidity, drawn fowls will keep from twenty to thirty days longer than those not drawn. The presence

of nndigested food and of excrementitions snbstances in animals which have been killed most certainly favors tainting of the flesh and general decomposition. The viscera are the first parts to show pntrescence, and allowing these to remain within the body can not do otherwise than favor infection of the flesh with bacteria and ptomaines, even if osmosis does not actually carry pntrid juices to contiguous tissues. Hnnters know the valne of drawing birds as soon as possible after they have been shot, in order to keep them sweet and fresh and to prevent their having a strong intestinal flavor.

That the opening of the body of an animal and exposing the internal surfaces to the air may have some influence of itself in hastening putrefaction is admitted, bnt when the process of drawing is properly condncted this secondary objection to its immediate performance may be entirely set aside. Absolnte cleanliness should be maintained throughont the operation, and if the entrails are torn and their



A. B.

FIG. 3.—Method of tying up legs, pushing head under the wing, and hanging turkey: *A*, breast view; *B*, side view.

contents allowed to come in contact with the flesh of the animal its interior shonld be at once washed out with clean cold water and afterwards with a solntion of common salt and the carcass hnng np until thoroughly dry.

THE CURING OF CHEESE.

The limited use of cheese as a constant article of diet in the United States has been attributed to the lack of uniformity in the quality of this product, and also to the fact that the cheese is so often poor Causes producing poor cheese are bad milk, faulty making and improper curing. The production of pure milk and its proper han dling for cheese making have long received much of the attention

demanded by the importance of these subjects. Methods of making have also been extensively and successfully studied. The curing of cheese, however, has only lately been investigated from a scientific standpoint. Among the American experiment stations working upon this subject are those of Wisconsin, New York, and Iowa, and recent publications of these stations have not only contributed toward an understanding of the causes of the ripening of cheese, but have given results of great practical value in the production of cheese of better and more uniform quality by improved methods of curing.

At the Wisconsin Station the influence of temperature and moisture upon the ripening of cheese was tested. Cheese was cured in a refrigerator at a temperature of 50° F., in an ordinary curing room at a temperature ranging from 60° to 65°, and at an unusually high temperature of 85°. The moisture in the refrigerator ranged from 86 to 90 per cent and in the curing room averaged 95 per cent. Five series of experiments were carried out, in each of which from three to five full-sized cheeses were made from mixed milk under similar conditions. All specimens were examined from time to time and scored by an expert, who was not informed of the conditions of curing.

The value of the refrigerator cheese was placed at $7\frac{3}{4}$ cents per pound, while that cured in the high temperature was rated, because of a rank flavor, at 3 or 4 cents per pound. The cheese cured at 60° to 65° was given a value about that of the refrigerator cheese. The high temperature very much hastened the ripening process, with the effect of lowering both the texture and the flavor, as well as developing a sharp, biting taste. Cheese cured at 55° and below was invariably of good quality, though mild in flavor, while, contrary to general opinion, no bitter taste was developed. The loss in drying out was much greater with the cheese ripened at the higher temperatures. Although it took much longer to ripen cheese at a lower temperature the quality was not only better, but the keeping period was lengthened.

To increase the moisture of the curing room and to avoid the excessive drying out of the cheese, the station employed wet cloths, which were hung over small water pipes with small holes drilled through the top every 6 inches. The water oozing through the holes kept the cloths wet and the room moist.

At the Ontario Agricultural College several series of experiments were carried out in curing cheese at different temperatures. The report for 1898 states that the different cheeses made under like conditions were kept four or five months at temperatures ranging from 60° to 92° and scored several times by different judges. In nearly every case there was a marked difference in favor of the cheese cured at about 60°. The average score for the season of cheese cured at 60° was nearly three points higher than that of cheese cured at 66° and five points higher than that cured at 69°. The cheese cured at 60° was better in both flavor and texture than that cured at higher tem-

peratures, and was pronounced as being worth from 2 to 3 cents per pound more than similar cheese cured at 70° to 75°. The average monthly shrinkage in cheeses weighing about 30 pounds each and cured at 60°, 66°, and 69° was, respectively, 3.40, 3.85, and 4.31 per cent.

These experiments were repeated the following year, the curing room being divided into three compartments and kept at temperatures of about 60°, 65°, and 70°, respectively. The cheeses made from similar milk each day from May to October were divided into three lots, placed in the different rooms, and scored at different times by several experts. As in the earlier work, cheese cured at 60° was better than that cured at higher temperatures, though the differences were not so marked. Cheese cured at 70° lost one-half per cent more in weight in one month than cheese cured at 60°. It is estimated that a factory making half a ton of cheese per day would lose 5 pounds more in curing at 70° than at 60°, which during a season would amount to a loss of about $100 in shrinkage alone.

Experiments were also made in keeping new-made cheese at a high temperature for a week and then placing it in cool rooms. Although advocated by some authorities, no advantage was found to result from this method of handling.

The results of experiments at the New York State Station show very conclusively that low temperatures for curing give a much better and more uniform cheese. In 1899 four curing rooms were used, with temperatures of 55°, 60°, 65°, and 70°, respectively. The rooms were arranged so that the temperatures could be kept uniform automatically, while cloths kept continuously wet were suspended in the rooms, so that the percentage of moisture would remain fairly constant. Without exception the cheeses cured at the lower temperatures scored highest, there being a difference between the average of the cheeses cured at 60° and below, and 65° and above, of five points in flavor and two and one-half points in texture. These experiments were repeated in 1900 with practically the same results.

At the Iowa Station a study was made of the influence of climate on the curing of cheese, and also of the advisability of constructing central curing rooms. It was found that the best cheese was produced and excessive losses prevented by curing at a low temperature and with a proper degree of moisture to prevent undue evaporation. As both the temperature and the moisture may be controlled in well-constructed curing rooms, it was believed that the influence of climate may be left out of consideration in selecting a cheese-producing area.

In studying the question of central curing rooms the station shipped cheese fresh from the press to and from Canada to be cured. The distance was 750 miles, and the cheese was sent, without ice, during the heat of summer. Cheese was also placed in a warm room for five days before placing in the curing room. The curing room was kept

damp by means of a box of moist pine shavings over the ventilator. From the results in comparison with cheese put into the curing room from the press the temperature did not seem to affect the quality of the cheese the first four or five days. The conclusion was drawn that "cheese can be exposed the first five days to a temperature as high as 90° without injuring its flavor if sufficient acid has been developed to make a firm-bodied cheese and it is cured at 60° afterwards."

FIG. 4.—Arrangement of two cow stalls facing each other.

From the results of these experiments it is apparent that better constructed curing rooms should be made at a great many of our factories. The increase in the quality of the cheese will result in an increased consumption, and therefore greater demand and higher prices, while the avoidance of excessive shrinkage will often pay for the extra cost of construction. The building of cooperative curing rooms, where the product of several factories may be sent, is also worthy of consideration. This, while lessening the expense, may also facilitate the proper handling under an expert, as well as the grading and the sale of the product. By better curing, the period during which the cheese is in best condition for sale will also be materially lengthened.

AN IMPROVED COW STALL.

A great deal of attention has been given to devising satisfactory stalls for cattle, and many different forms of stalls, fasteners, and mangers have been proposed. Some of these possess merit and are widely used; others are worthless. In a recent report of the Indiana Station, H. E. Van Norman gives the following as the requisites of an ideal cow stall: It should be strong and inexpensive and so constructed as to keep the animals clean and prevent them from frightening or injuring each other. It should be provided with a fastener which holds the animal securely, is easy to fasten and unfasten, is so arranged that there is no danger of the animals getting their feet caught in it, and gives the maximum amount of liberty commensurate with cleanliness. A manger should be provided which is easily cleaned and holds the necessary amount of feed and coarse fodder and prevents it from being scattered under the feet of the animals. The following is a description of a stall believed to possess these features, and which has given excellent satisfaction at the Indiana Station:

Figure 4 represents the arrangement for two rows of stalls facing each other with the feeding alley raised to the top of the manger, allowing feed and hay to

be swept into the manger and refuse to be swept out of the manger into the alley for removal. The stall may be constrncted of 2-inch lumber, dressed on two sides, or, if to be whitewashed, 1½-inch stuff, rough, will hold the whitewash better than if smooth. These are standard sizes of lumber, bnt 1½ dressed and 1¼

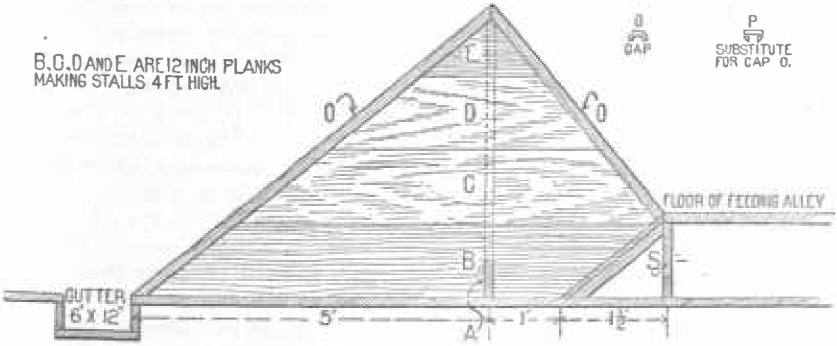


FIG. 5.—Details of construction of cow stalls, side view.

rongh are strong enongh. For dairy cows of average size stalls 3 feet 6 inches from center to center and 5 feet from gutter to manger will be abont right. The animal

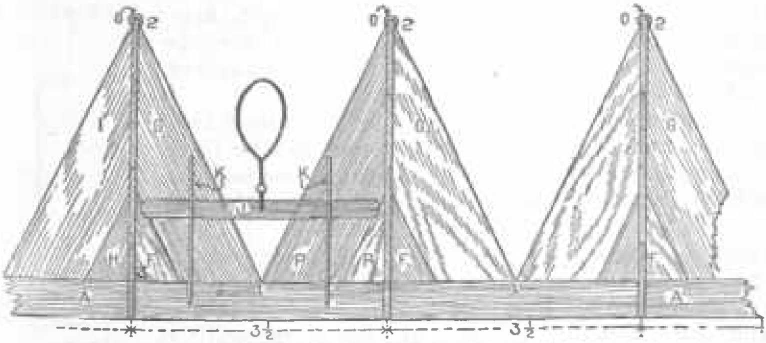


FIG. 6.—Details of construction, end view.

should have jnst room to stand comfortably with hind feet an inch from the gutter and front feet jnst back of A in fig. 5. A desirable arrangement is to place

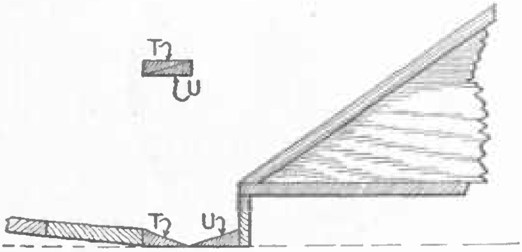


FIG. 7.—Arrangement of alley floor without a gutter.

the timber A 5 feet from the gutter at one end of the barn and enongh closer at the other end to fit the smallest animal, thus giving the stalls varied lengths.

To build the stall, place the 2 by 6 A (fig. 5) in position 5 feet or less from the gntter, then the raised feeding floor shonld be bnilt with the joist S 2½ feet in the

clear from A; then cut the plank B and fasten in place, and successively planks C, D, and E, holding them temporarily with a cleat until F and G are secured. To cut F and G, lay two pieces of plank on the floor, and on the one G (fig. 8) lay off the distance 1 to 2 along the edge equal to the distance from the top of partition 2 (fig. 6) to middle of manger on top of A at 1 (fig. 6), then mark off 2–3 and 3–1, making the corner at 3 exactly square. It will make little difference if planks G and P (fig. 6) do not touch at 1. When properly fitted, toe-nail G to A at 1, and nail B, C, D, and E to F and G; then toenail H and I in place. The partition between stalls is now held securely in place and the operation may be repeated for as many stalls as wanted.

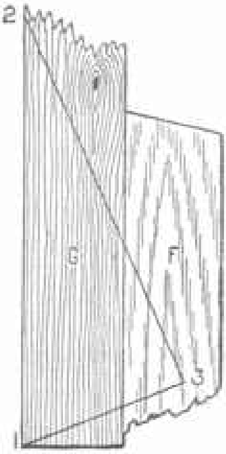


FIG. 8.—Method of cutting boards for stall.

It is well to leave the planks B, C, D, E a little long, or even square, and when in position draw lines from 4 to 5 and 4 to 6 (fig. 5) and saw off along these lines. The ends of the planks B, C, D, and E should be covered with a partition cap O (fig. 5), which holds them in place and gives a finished appearance to the stalls. In the absence of the capping O, strips, as shown at P (fig. 5), may be used.

The bar J (fig. 6) should be 1 inch shorter than the distance between partitions and made of 1 by 3 light, strong wood, round corners, and slides behind iron staples K, figs. 6 and 9, which are made of half-inch round iron with nuts on the end or with a hole and key. These staples K should be placed 9 inches from the partition and lower end near the floor.

In the middle of J place a clevis of 1 by ⅛-inch strap iron, in which to fasten a common chain tie. Bore hole for clevis bolt just above the middle of bar. This bar should hang far enough from the neck to allow the cow to stand comfortably with the head in a natural position.

FIG. 9.—Iron staple for holding hitching bar.

Where conditions make the feeding alley impracticable, the front of the manger may be arranged on the plan of the dotted lines in fig. 5. If desired, a 2 by 2-inch piece may be run along on top of the stalls at 2 (fig. 6), though it is not recommended.

It has been suggested that instead of the gutter a drop be arranged, as shown in fig. 7. T and U are made of a 2 by 6 inch piece split diagonally.

O